INFORMATION STORAGE MEDIUM INCLUDING MARKUP DOCUMENT AND AV DATA, RECORDING METHOD, REPRODUCING METHOD, AND REPRODUCING APPARATUS THEREFOR

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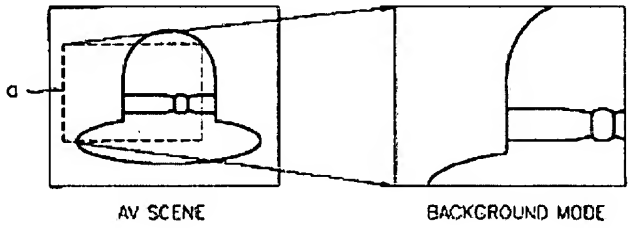
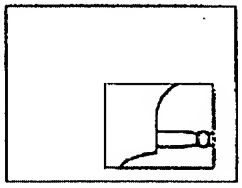
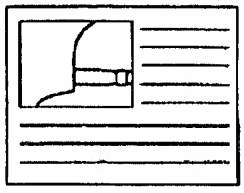
Abstract of **WO03036460**

An information storage medium including a markup document and AV data, a recording method, a reproducing method, and a reproducing apparatus therefor are provided. The information storage medium includes AV data including audio data and video data, a markup document, and scene synthesis information which describes one of at least two display modes for displaying a markup document scene obtained from the markup document and an AV scene obtained from the AV data together.







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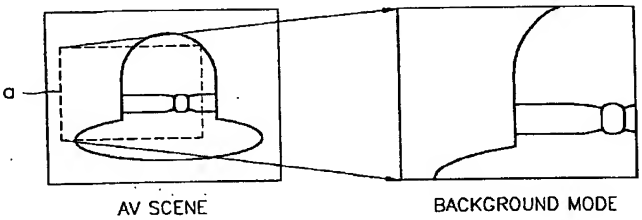
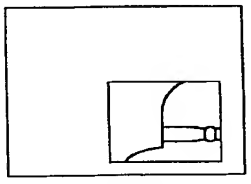
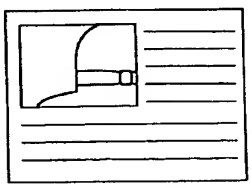
[Continued on next page]

(54) Title: INFORMATION STORAGE MEDIUM INCLUDING MARKUP DOCUMENT AND AV DATA, RECORDING METHOD, REPRODUCING METHOD, AND REPRODUCING APPARATUS THEREFOR







(57) Abstract: An information storage medium including a markup document and AV data, a recording method, a reproducing method, and a reproducing apparatus therefor are provided. The information storage medium includes AV data including audio data and video data, a markup document, and scene synthesis information which describes one of at least two display modes for displaying a markup document scene obtained from the markup document and an AV scene obtained from the AV data together.

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INFORMATION STORAGE MEDIUM INCLUDING MARKUP DOCUMENT AND AV DATA, RECORDING METHOD, REPRODUCING METHOD, AND REPRODUCING APPARATUS THEREFOR

Technical Field

The present invention relates to a method for displaying AV data together with a markup document, and more particularly, to an information storage medium including a markup document and AV data so that the markup document and the AV data can be reproduced and displayed together in various ways in an interactive mode, a recording method, a reproducing method, and a reproducing apparatus therefor.

Background Art

Digital video discs (DVDs), (hereinafter, referred to as "interactive DVDs") on which a markup document is recorded together with AV data, have been initially developed for movie applications and later started to be widely used in a computer industry. AV data recorded on interactive DVDs can be reproduced in two ways: a video mode displayed identically in a conventional DVD, and an interactive mode in which reproduced AV data is displayed in a display window defined by a markup document. If the interactive mode is selected by a user, a viewer installed in a DVD reproducing apparatus displays a markup document recorded on an interactive DVD. AV data selected by the user is displayed in the display window of the markup document. For example, when the AV data is a movie, the movie is run in the display window of the markup document, and various additional information including scenario, history, and actors' pictures related to the movie are displayed in the remaining part of a screen excluding the display window of the markup document. The additional information includes image files or text files.

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recorded in the markup document, and more preferably, the scene synthesis information includes a cascading style sheet (CSS) inserted in the link tag.

The CSS includes at least one of display mode designation information for designating a display mode of the AV scene, an AV trimming area designation information for designating an area to increase and reduce a desired portion of the AV scene, background color designation information for designating a background color of the AV scene, trimming area designation information for designating a trimming area of a scene in which the AV scene is synthesized with the markup document, window designation information for designating a window in which a scene where the AV scene is synthesized with the markup document is displayed on the screen of a display, screen display type information representing an aspect ratio of a scene in which the AV scene is synthesized with the markup document scene, and window designation information of the AV scene for designating an area of a window in which a trimmed AV scene is displayed on the screen of the display.

Further, the scene synthesis information further includes an object having property variables for controlling the CSS and a program for controlling the CSS on the basis of the object.

To achieve the above aspects, according to another aspect of the present invention, there is provided a method for recording AV data including audio data and video data on an information storage medium. The method comprises (a) recording the AV data, (b) recording a markup document to be displayed together with the AV data, and (c) recording scene synthesis information which describes one of at least two display modes for displaying a markup document scene obtained from the markup document and an AV scene obtained from the AV data together.

In step (a), the AV data is recorded in a video directory, in step (b), the markup document is recorded in an interactive directory, and in step

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information, displaying an AV scene obtained by reproducing the AV data and a markup document scene obtained by reproducing the markup document to be displayed together with the AV data, and changing the output state of the markup document scene in response to scene mode change.

To achieve the above aspects, according to another aspect of the present invention, there is provided an apparatus for reproducing AV data including audio data and video data recorded on an information storage medium. The apparatus includes a reading unit which reads the AV data and a markup document to be displayed together with the AV data, a decoder which decodes the AV data read by the reading unit and outputs an AV scene, and a controller which interprets the markup document read by the reading unit, outputs a markup document scene, interprets scene synthesis information which describes at least two display modes for displaying the markup document scene together the AV scene, and displays the AV scene and the markup document scene in one of the display modes according to the interpreted scene synthesis information.

To achieve the above aspects, according to another aspect of the present invention, there is provided an apparatus for reproducing AV data including audio data and video data recorded on an information storage medium. The apparatus includes a reading unit which reads the AV data and a markup document to be displayed together with the AV data, a decoder which decodes the AV data read by the reading unit and outputs an AV scene, and a controller which interprets scene synthesis information corresponding to a scene mode set in a reproducing apparatus or set by a user, interprets the markup document to be displayed together with the AV data read by the reading unit using the interpreted scene synthesis information, displays a markup document scene, and changes the output state of the markup document scene in response to scene mode change.

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FIG. 13 shows a reference diagram illustrating scenes in which AV data for 16 x 9 is displayed on a display for 4 x 3 in a letter box shape and a pan & scan shape;

FIG. 14 shows a reference diagram illustrating a markup document using the concept of a hot area;

FIG. 15 shows variations in coordinate systems needed in mapping the area selected using viewport: to the area designated using window:;

FIG. 16 shows a flowchart of another preferred embodiment of a reproducing method according to the present invention

FIG. 17 shows a reference diagram in which AV data for 16 x 9 is synthesized with a markup document for 4 x 3 in embedded, background, and PIP modes, respectively,

FIG. 18 shows a reference diagram in which the AV data for 16 x 9 is synthesized with the markup document for 4 x 3 in a background mode, and then is displayed on a display for 16 x 9;

FIG. 19 shows a reference diagram illustrating a display, a markup document, and AV data according to different aspect ratios;

FIG. 20 shows a reference diagram illustrating the ratio of width to length in pixels in a display for 16 x 9 and the ratio of width to length in pixels in a display for 4 x 3;

FIG. 21 shows a reference diagram illustrating various aspect ratio conversion;

FIG. 22 shows a reference diagram in which AV data for 16 x 9 and a markup document for 4 x 3 each having a window area are synthesized with each other, and then is displayed on a display for 16 x 9; and

FIG. 23 shows a flowchart of another preferred embodiment of a reproducing method according to the present invention.

Best mode for carrying out the Invention

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through an application program interface (API), and a client interpretation engine. The API is a predetermined special method for requesting processing of an operation system or another application. The client interpretation engine is implemented with a JavaScript or Java interpretation engine, interprets a program coded with JavaScript or Java, like a web browser and executes the program. Furthermore, the presentation engine 3 may further include a Plug-In. The Plug-In enables files in various formats included in the markup document or called by the markup document, to open. The presentation engine 3 interprets the scene synthesis information according to the present invention and transmits a decoding command and a display command according to the result of interpretation to the AV decoder 2 and the blender 4, respectively. The presentation engine 3 also provides the markup document scene to the blender 4. The AV decoder 2 decodes the AV data according to the provided decoding command and outputs the decoded AV data to the blender 4. The blender 4 displays the markup document scene and the AV scene together according to the display command.

In order to perform a reproducing method according to an embodiment of the present invention, the presentation engine 3 calls a style sheet linked to or embedded in the markup document manufactured by the reading unit 1 and interprets the style sheet. Information on a method for synthesizing (displaying) the markup document scene and the AV scene is described in the style sheet.

In order to perform the reproducing method according to another embodiment of the present invention, the presentation engine 3 interprets a screen mode (aspect ratio, resolution, and video output mode) set in the reproducing apparatus or set by the user and outputs a command according to the set screen mode using scene synthesis information which is defined using a default style sheet set in the reproducing apparatus or a style sheet provided by a manufacturer (in

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interprets viewport and window (document-viewport:, document-window:) only for the markup document defined in the scene synthesis information, respectively, and viewport and window (video-viewport:, video-window:) only for the AV data. In order to perform the reproducing method according to yet still another embodiment of the present invention, unlike the AV decoder 2 having a switching unit, even though the display is set to the 4 x 3 size, in the embedded mode or PIP mode, the AV decoder 2 having no additional switching unit outputs the AV stream for 16 x 9, in such a way that the display is set to the 16 x 9 size, without outputting the AV stream in the letter box or pan & scan shape according to the viewport and window only for the interpreted markup document and the viewport and window only for the AV data.

FIG. 2 is a reference diagram illustrating a scene alignment order (Z-order) of a display (not shown) connected to the reproducing apparatus of FIG. 1. Referring to FIG. 2, a final scene shown to the user is generated by four scenes added physically. A scene 21 on which a pointer is displayed, is placed foremost, followed by a markup document scene 22 according to the markup document, an AV scene 23 according to the AV data, and a background scene 24 generally displayed in a single color.

FIG. 3 shows the structures of files of the DVD 100 of FIG. 1 according to a preferred embodiment of the present invention. Referring to FIG. 3, a video directory VIDEO_TS including AV data, and an interactive directory DVD_ENAV including data for supporting an interactive function, such as a markup document, are provided in a root directory. AV data and reproduction control information (also, known as navigation data) are recorded in the video directory VIDEO_TS. The reproduction control information includes information referred to, so as to decode the AV data. The markup document and the scene synthesis information are recorded in the interactive directory DVD_ENAV.

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scene, as described with reference to FIG. 2. The PIP mode enables the AV scene to seem to be output on the markup document scene from a user's viewpoint. Preferably, the PIP mode is subdivided by the placement location and size of the AV scene. In the present embodiment, the PIP mode is divided into several shapes using PIP-# such as PIP-1 and PIP-2. In the PIP mode, the user can change the location and size of the AV scene using a remote controller (not shown). Meanwhile, an example of an XML code for constituting the markup document A.HTM shown in FIG. 4 is as follows.

```
<?xml version="1.0"?>
<!DOCTYPE html
    PUBLIC "-//DVD//DTD XHTML DVD HTML 1.0//EN"
    "http://www.dvdforum/dvdenav/dvdhtml-1-0.dtd">
<html>
    <head>
        <title>DVD HTML PIP mode sample</title>
        <link rel="stylesheet" type="text/css" href="a.css">
    </head>
    <body onload="dvdvideo.play();">
        <table border="0" width="720" height="480">
            <tr>
                <td>
                    <img src="a.png" width="100%" height="100%" border="0"/>
                </td>
            </tr>
        </table>
    </body>
</html>
```

A. HTM

It is apparent that a style sheet file A.CSS is linked to the above source code using a link tag. An example of a style sheet source code is as follows.

```
@screen-display
{
video-placement: pip
background-color: #00000000
viewport : rect(0px,719px,479px,0px)
window: rect(0px,719px,479px,0px)
video-viewport: rect(0px,719px,479px,0px)
}
```

A. CSS

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```
            <tr>
                <td width="277" height="296">
                    <img src="b2.png" width="277" height="296" border="0"/>
                </td>
            </tr>
        </table>
    </body>
</html>
```

B.HTM

```
@screen-display
{
video-placement: embedded
background-color: #00000000
viewport : rect(0px,719px,479px,0px)
window: rect(0px,719px,479px,0px)
video-viewport: rect(0px,719px,479px,0px)
}
```

B.CSS

A display window in which the AV scene is to be displayed using an object tag, is defined in B.HTM. That is, the area of the display window is determined by properties such as "width" and "height" in the "object" tag. In addition, it is apparent that a style sheet file B.CSS is linked to B.HTM using a link tag. Here, B.CSS means a cascading style sheet (CSS) file. CSS enables "style" of the markup document to be described. Alternatively, the style sheet file can be lined to B.HTM using a style tag.

FIG. 6 shows a background mode, as one display mode according to the present embodiment. Referring to FIG. 6, in the background mode, the markup document scene is output on the AV scene. An example of an XML code for constituting the markup document C.HTM shown in FIG. 6 and an example of a style sheet source code are as follows. Similarly, a style sheet file C.CSS is linked to C.HTM using the link tag.

```
<?xml version="1.0"?>
<!DOCTYPE html
    PUBLIC "-//DVD//DTD XHTML DVD HTML 1.0//EN"
    "http://www.dvdforum/dvdenav/dvdhtml-1-0.dtd">
<html>
    <head>
        <title>DVD HTML Background sample</title>
        <link rel="stylesheet" type="text/css" href="c.css">
```


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="dvd:"> represents a background in a window defined to output the markup document scene. That is, in the background mode according to the present embodiment, the AV scene is displayed in the entire scene but if the background using the body tag is designated, the AV scene is displayed only in a predetermined window scene.

2. **background-color:** It designates a background color of a scene formed of a single color. A value is <color>, and an initial value may vary according to a user agent (UA).

3. **window:** It designates a window in which a scene where the AV scene is synthesized with the markup document scene, is displayed. A value is <shape>, and an initial value is rect (0%, 100%, 100%, 0%).

4. **viewport:** It designates a trimming area of the scene in which the AV scene is synthesized with the markup document scene. A value is <shape>, and an initial value is rect (0%, 100%, 100%, 0%).

5. **video-viewport:** It designates an area to increase and reduce a desired portion of the AV scene. A value is <shape>, and an initial value is rect (0%, 100%, 100%, 0%). Here, the value of the defined <shape> is rectangle (<top>,<right>,<bottom>,<left>).

FIG. 7 shows a reference diagram more specifically illustrating a display mode of the AV scene and the markup document scene according to video-viewport: and video-placement:. Referring to FIG. 7, if an area **a** for increasing and reducing from the AV scene is designated by video-viewport:, when video-placement: is a background mode, a trimming area **a** is displayed in a background scene, and a markup document scene (not shown) is displayed in the trimming area **a**. When video-placement: is a PIP mode, the trimming area **a** is displayed in a designated location. When video-placement: is an embedded mode, the trimming area **a** is embedded in a display window defined by a markup document and is displayed in the display window. FIG. 7 shows

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A property variable for designating a display mode, a property variable for designating a background color of an AV scene, a property variable for designating a window of a scene in which the AV scene is synthesized with a markup document scene, a property variable for designating a trimming area of the scene in which the AV scene is synthesized with the markup document scene, and a property variable for designating an area to increase and reduce a desired portion of the AV scene are defined in an object for controlling the above-mentioned CSS file.

In addition, the AV scene may be increased/reduced according to a user's input using an object source code of an application program interface (API) for a document object model (DOM). The value of the object source code needed in performing this operation can be referred to using a script language in the markup document.

The following object source code is used to bind "ScreenDisplayProperties" in root elements (i.e., <frameset> and <html>) of the uppermost level.

```
Interface ScreenDisplayProperties {
    attribute ScreenDisplayRule screenDisplayInfo;
}
```

Here, "ScreenDisplayProperties" are connected to root elements of a markup document, and the value of "ScreenDisplayProperties" can be referred to using a script language in the markup document. An example of the object source code is as follows.

```
IDL Definition
Interface ScreenDisplayRule
{
                attribute unsigned short videoPlacement;
                attribute DOMString      colorBackground;
                attribute DOMString      viewport;
                attribute DOMString      window;
                attribute DomSting       videoViewport;
};

Attributes
videoPlacement: It designates a display mode of a DVD-video.  That is, it represents that
        const unsigned short VIDEO_PLACEMENT_NONE = 0;
        const unsigned short VIDEO_PLACEMENT_EMBEDDED = 1;
```


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```
        if (evt == 2)
        { // evt == 2 : Reduce an AV scene to a designated size
            vdi = document.documentElement.screenDisplayInfo;
            vdi.videoPlacement = 1;
            vdi.colorbackground = "black";
            vdi.videoviewport = "rect(0px,719px,479px,0px)"
            vdi.window="rect(10%,90%,90%,10%)
            // Here, a % value is a relative value for "width" and "height" defined by the
tag "Object".
        }

        }
      -->
    </script>
  </head>
  <body onload="dvdvideo.play();">
  <table border="0" width="720" height="480">
    <tr>
      <td width="277" height="184" align="left" valign="top">
        <object data="dvd": width="277" height="184" border ="0"/>
      </td>
      <td width="443" height="480" align="left" valign="top" rowspan="2">
        <img src="b1.png" width="443" height="480" border="0"/>
      </td>
    </tr>
    <tr>
      <td width="277" height="296">
        <input type="button" value="Zoom-In" onClick="zoom(0)"/>
        <input type="button" value="Restore" onClick="zoom(1)"/>
        <input type="button" value="Zoom-Out" onClick="zoom(2)"/>
      </td>
    </tr>
  </table>
  </body>
</html>
```

In this way, the scale of the AV scene can be manipulated through a user's input using the API for a DOM and the script language.

Accordingly, the AV scene and the markup document scene are freely synthesized with each other according to the above-mentioned embodiment, and the display location of the AV scene can be set by a style sheet linked to the markup document or embedded in the markup document, thereby allowing a user to enjoy scenes in various shapes.

A reproducing method according to the present invention will be described below based on the above structure.

FIG. 9 shows a flowchart illustrating a preferred embodiment of a reproducing method according to the present invention. Referring to

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sheet file, the AV scene is overlapped on the markup document scene and is displayed. In step 905-2, when the embedded mode is described in the style sheet file, the AV scene is embedded in the markup document scene and is displayed. In step 905-3, when the background mode is described in the style sheet file, the markup document scene is overlapped on the AV scene and is displayed.

FIG. 10 shows a flowchart specifically illustrating steps subsequent to step 903 of FIG. 9. Referring to FIG. 10, the presentation engine 3 interprets the CSS file in the markup document or the link tag and calls the CSS file in step 1001, interprets the called CSS file in step 1002, and reads the display mode designation information and the AV trimming area designation information, which are described in the CSS file in step 1003. The blender 4 blends and outputs the command and the markup document scene provided from the presentation engine 3 and the AV scene provided from the AV decoder 2, and the markup document scene and the AV scene are displayed according to the display mode described in the CSS file in step 1004. In the case of a none mode, the AV scene is not displayed in step 1004-1. Otherwise, one of the PIP mode (step 1004-2), the background mode (step 1004-3), and the embedded mode (step 1004-4) may be displayed.

FIG. 11 shows a flowchart illustrating a preferred embodiment of a recording method according to the present invention. Referring to FIG. 11, the recording apparatus records the AV data on an information storage medium (step 1101), records the markup document that is to be reproduced with the AV data on the information storage medium (step 1102), and records the above-mentioned scene synthesis information in the style sheet file linked to or embedded in the markup document (step 1103). In step 1103, an object having property variables for controlling the style sheet file in the markup document and a program for controlling

screen aspect ratios so as to correspond to a display having different aspect ratios.

In order to display interactive contents that are not distorted in the display having different aspect ratios as shown by ① and ②, the manufacturer prepares respective markup documents by considering different aspect ratios of the display as shown by ③ and ④, and respective AV data (i.e., AV contents of DVD-video format) by considering different aspect ratios of the display as shown by ⑤ and ⑥. Contents of ③ + ⑤ in which AV data for 4 x 3 is synthesized with a markup document for 4 x 3 can be displayed on the screen of a display for 4 x 3 as shown by ①, and contents of ④ + ⑥ in which AV data for 16 x 9 is synthesized with a markup document for 16 x 9 can be displayed on the scene of a display for 16 x 9 as shown by ②, as contents which the manufacturer wants, without performing any special operation.

Second displaying method: The manufacturer prepares respective markup documents by considering aspect ratios of a display, and AV data corresponds to a display having different aspect ratios in the following way when contents having a fixed aspect ratio are manufactured.

When only ③, ④, and ⑤ are manufactured

- When displaying on a display for 4 x 3: The contents of ③ + ⑤ in which the AV data for 4 x 3 is synthesized with the markup document for 4 x 3 can be displayed in a scene ①, as contents which the manufacturer wants, without performing any special operation.
- When displaying on a display for 16 x 9: The AV data ⑤ for 4 x 3 is embedded in the markup document for 16 x 9 including right and left blanks without expansion. Only the right and left blanks may be eliminated by setting the size of an object tag of the markup

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difference in picture beauty of the 4 x 3 pan & scan scene depending on an editor's skill.

Letter box is a picture manufactured by inserting a black band in upper and lower portions of a scene and reducing the scene so that the user can effectively view a picture manufactured in a wide scene format (16 x 9) in a normal display (screen ratio 4 x 3). The upper and lower black bands of the picture are referred to as "Matte".

- When displaying on a display for 16 x 9: The contents of ④ + ⑥ in which AV data for 16 x 9 is synthesized with a markup document for 16 x 9, can be displayed in a scene 2, as contents which the manufacturer wants, without performing any special operation.

Third displaying method: The manufacturer prepares respective AV data by considering aspect ratios of a display, and a markup document corresponds to a display having different aspect ratios in the following way when contents having a fixed aspect ratio are manufactured.

When only ③, ⑤, and ⑥ are manufactured

- When displaying on a display for 4 x 3: The contents of ③ + ⑤ in which AV data for 4 x 3 is synthesized with a markup document for 4 x 3, can be displayed in a scene 1, as contents which the manufacturer wants, without performing any special operation.

- When displaying on a display devcie for 16 x 9: AV data 6 for 16 x 9 is converted into a shape of a 4 x 3 normal scene, 4 x 3 letter box scene, or 4 x 3 pan & scan scene and then is embedded in a markup document 3 for 4 x 3. The manufactured contents of 3 + 6 can be displayed to include blanks on the right and left sides of a scene 2 through middle alignment.

When only ④, ⑤, and ⑥ are manufactured

- When displaying on a display for 4 x 3: AV data 5 for 4 x

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display for 4 x 3 through a concept of "hot area" and an API with respect to aspect ratio conversion. In this case, preferably, the pan & scan or letter box is applied to the video mode other than the interactive mode.

- When displaying on a display for 16 x 9: The contents of ④ + ⑥ in which AV data is synthesized with a markup document, can be displayed in a scene ② as the manufacturer wants, without performing any special operation.

Here, "hot area" and the API with respect to the aspect ratio conversion will be described in greater detail.

When interactive contents manufactured for use in 16 x 9 (resolution of 854 x 480) are displayed on a display for 4 x 3 (resolution of 640 x 480), only a 640 x 480 area of the entire area of the interactive contents is displayed on the display for 4 x 3, the other 214 x 480 area is not displayed on the display for 4 x 3. Therefore, the manufacturer includes contents which should be displayed on a 640 x 480 area (in the present invention, the displayed maximum area is referred to as "hot area" regardless of an aspect ratio of a display), which can be displayed regardless of an aspect ratio of a display during initial layout, and includes unimportant contents or does not include any contents in the other area. In order to display a markup document manufactured by the concept of "hot area" on a display for 4 x 3 and in order to display an AV scene and a markup document scene in various ways, interactive contents are displayed using the above-mentioned properties "viewport:" and "window:" used in the object source code of the API for a DOM, and descriptions thereof will be described later.

Hereinafter, a simple example in which interactive contents for 16 x 9 are displayed on a display for 4 x 3 regardless of an aspect ratio of a display, will be described with reference to FIG. 14.

The manufacturer constitutes a markup document using the concept of "hot area" so as to display a scene that is not distorted

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The above Equations 1 through 4 are based on a markup document, but if a lower subscript "document" is changed into "video", the definition of AV data is made.

An example of an optimum table showing the size of each area through the above-mentioned displaying methods at a pixel size ratio of 1 x 1 to easily recognize a document area, a viewport area, a window area, and a screen area and the size of an area through other available displaying methods is as follows.

Case	Document area	Viewport Area	Window area	Screen Area
When interactive contents manufactured for 640 x 480 are displayed on a 640 x 480 display	640 x 480	640 x 480	640 x 480	640 x 480
When interactive contents manufactured for 640 x 480 are displayed on a 854 x 480 display	640 x 480	640 x 480	640 x 480	854 x 480
When interactive contents manufactured for 640 x 480 are displayed on a 854 x 480 display	640 x 480	640 x 480	854 x 480	854 x 480
When interactive contents manufactured for 854 x 480 are displayed on a 640 x 480 display	854 x 480	854 x 480	640 x 480	640 x 480
When interactive contents manufactured for 854 x 480 are displayed on a 640 x 480 display	854 x 480	854 x 480	640 x 480	640 x 480
When interactive contents manufactured for 854 x 480 are displayed on a 640 x 480 display	854 x 480	640 x 480	640 x 480	640 x 480
When interactive contents manufactured for 854 x 480 are displayed on a 640 x 480 display	854 X 480	854 x 480	854 x 480	854 x 480

Meanwhile, reproducing methods according to an aspect ratio are largely classified by a static method using a CSS and a dynamic method using an API for a DOM. When interactive contents are initially

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the AV scene is synthesized with the markup document scene, is displayed. A value is <shape>, and an initial value is rect (0%, 100%, 100%, 0%).

6. **viewport:** It designates a trimming area of the scene in which the AV scene is synthesized with the markup document scene. A value is <shape>, and an initial value is rect (0%, 100%, 100%, 0%).

```
@screen-display 4x3N
{
background-color : #000000
viewport : (0px,629px,479px,90px)
window : (0px,719px,479px,0px)
video-viewport : (0px,719px,479px,0px)
}

@screen-display 4x3L
{
background-color : #000000
viewport : (0px,719px,479px,0px)
window : (60px,719px,419px,0px)
video-viewport : (0px,719px,479px,0px)
}

@screen-display 4x3P
{
background-color : #000000
viewport : (0px,629px,479px,90px)
window : (0px,719px,479px,0px)
video-viewport : (0px,629px,479px,90px)
}

@screen-display 16x9W
{
background-color : #000000
viewport : (0px,719px,479px,0px)
window : (0px,719px,479px,0px)
video-viewport : (0px,719px,479px,0px)
}
```

Since the default style sheet is differently set in each reproducing apparatus, a scene cannot be usually displayed as the manufacturer wants. Thus, preferably, the manufacturer makes an additional CSS in the markup document and attaches the CSS to the document so that the user can effectively display the AV data (DVD-video) and the markup document manufactured at a fixed aspect ratio, even at an aspect ratio

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```
        }
      </style>
    </head>
    <body id="bodyNode">
    .....
    </body>
</html>
```

In this way, documents initially displayed by statically applying the CSS are displayed in a scene through the structure of processing shown in the following table in the presentation engine, and a corresponding page of a document of which aspect ratio is changed during reproduction should be reloaded to guarantee a right scene. If the corresponding page of the document is not reloaded and is displayed in the scene, the scene of the markup document may be distorted, or the markup document may be not mapped to the AV data.

```
If (Initial Display aspect ratio==4x3 && (no_video == 1   current display == nomal))
{
    apply@screen-display 4x3N
else if (Initial Display aspect ratio==4x3 && current display == 4x3P)
{
    apply@screen-display 4x3P
else if (Initial Display aspect ratio==4x3 && current display == 4x3L)
{
    apply@screen-display 4x3L
else if (Initial Display aspect ratio==16x9)
{
    apply@screen-display 16x9W
}
```

In the above algorithm in the presentation engine, "Initial Display aspect ratio" corresponds to Initial Display aspect ratio of a system parameter SPRM(14) defined in DVD Specifications for Read-Only Disc/Part 3. "Initial Display aspect ratio" is a parameter obtained by initially setting an aspect ratio which the user prefers and has the values of two types of 4 x 3 and 16 x 9, as shown in the above algorithm.

A "no_video" element indicates whether there is AV data (i.e., DVD-video) in a markup document loaded initially. If the value of "no_video" element is "0", it is determined that DVD-video is included in

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window: It has the value of <shape> as a window area on a display to which the trimmed markup document is to be mapped.

videoviewport: It has the value of <shape> as a trimming area of AV data.

The above-mentioned dynamic definition using the object source of the API for the DOM is implemented by a script language included in the markup document, as shown in the following example. The example is made by the manufacturer by considering event handling according to user's aspect ratio conversion of AV data for 16 x 9 (i.e., DVD-video) and a markup document for 16 x 9, which are to be displayed in an embedded mode.

```
<?xml version "1.0" encoding="UTF-8"?>
<!DOCTYPE html PUBLIC "-//DVD//DTD XHTML DVD-HTML 1.0//EN"
                    http://www.dvdforum.org/envideo/dtd/dvdhtml-1-0.dtd">
<html>
   <head>
        <title>Example of aspect ratio change</title>
        <script type="text/javascript">
        <--
            function eventHandler(evt)
            {
            var vdi;

            if (evt.index == SCREEN_DISPLAY_MODE_CHANGE && (evt.param1 == 0))
            { // param1 == 0 : 4x3N
                vdi = document.documentElement.screenDisplayInfo;
                vdi.videoPlacement = 1;
                vdi.colorBackground = "black";
                vdi.viewport = "(0px,629px,479px,90px)"; // An area formed by cutting right
and left sides of a markup document is selected.  In this case, it is most preferable that
the selected area is consistent with a "hot area".
                vdi.window = "(0px,719px,479px,0px)";
                vdi.videoviewport = "(0px,719px,479px,0px)"
            }

            if (evt.index == SCREEN_DISPLAY_MODE_CHANGE && (evt.param1 == 1))
            { // param1 == 1 : 4x3L
                vdi = document.documentElement.screenDisplayInfo;
                vdi.videoPlacement = 1;
                vdi.colorBackground = "black";
                vdi.viewport = "(0px,629px,479px,90px)";
                vdi.window = "(0px,719px,479px,0px)";
                vdi.videoviewport = "(0px,719px,479px,0px)" // Even though the entire
DVD-video picture is selected, in a 4 x 3 letter box mode, it seems that "Matte" is added to
the upper and lower portions of a scene.
            }
```


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FIG. 16, by using the above-mentioned static and dynamic definitions, the markup document scene is displayed according to a screen mode (aspect ratio, resolution, and video output method) set by the user or set in the reproducing apparatus. The screen mode can be changed even during reproduction through a user's input. A viewport value and a window value of the markup document applied in this case can be applied to a next markup document as it is if these are not changed in a next markup document.

In step 1601, the presentation engine 3 reads the screen mode (aspect ration, resolution, and video output method) set in the reproducing apparatus or the screen mode set by the user. Here, a video output method means that a 16 x 9 video is output in a 4 x 3 letter box or 4 x 3 pan & scan, and 16 x 9 wide mode, which can be displayed without scene distortion.

When a display is set to a 4 x 3 size, the AV decoder 2 converts an AV stream into a letter box or pan & scan shape and outputs the converted AV stream. When the display is set to a 16 x 9 size, the AV decoder 2 outputs the AV stream in a 16 x 9 size without conversion. This is because the AV stream is generally encoded in the 16 x 9 size in the DVD reproducing apparatus. However, it is preferable that the output is performed only when the AV stream is reproduced in a video mode other than a conventional interactive mode, and in the interactive mode, the AV stream is always output in a 16 x 9 size.

In step 1602, a default style sheet in the presentation engine 3 is selected based on the set screen mode, and properties such as viewport, window, and video viewport, which are defined in the corresponding default style sheet, are determined.

The presentation engine 3 interprets the markup document read by the reading unit 1 and checks a style sheet linked to or embedded in the markup document. In step 1603, if there is no style sheet provided by the manufacturer in the markup document, the presentation engine 3

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manufactured at a fixed aspect ratio (screen ratio) with each other without scene distortion, the user can enjoy a display state the closest to manufacturer's intention, and simultaneously, using the markup document having a fixed aspect ratio (screen ratio), a disc space can be more effectively used by avoiding repeated recording of interactive contents.

First, when a storage medium, in which AV data (DVD-video) is manufactured to a 16 x 9 size and a markup document is manufactured to a 4 x 3 size, is displayed on a display for 16 x 9 through a reproducing apparatus, displaying methods according to displaying modes (embedded mode, background mode, and PIP mode) will be described with reference to FIG. 17.

First, a case where AV data for 16 x 9, as shown in (a) of FIG. 17, is synthesized with a markup document in an "embedded mode" embedded by "object" elements, as shown in (b) of FIG. 17, will be described. If the manufacturer sets "width" and "height" of the "object" tag in the markup document so that the AV data for 16 x 9 is expressed as it is, the entire synthesized scene is selected as a viewport area and is not expanded so that there is no scene distortion in a display for 16 x 9, and an area excluding right and left blanks is selected as a window area, and the synthesized scene is displayed, thereby the scene can be effectively displayed. However, if the manufacturer sets "width" and "height" of the "object" tag used to embed the AV data for 16 x 9 to a 4 x 3 screen ratio, the AV data will be embedded in the markup document in a normal shape, letter box or pan & scan shape, and the synthesized scene will be displayed on the display for 16 x 9 without expansion. In this case, even though the AV data is manufactured to a 16 x 9 size, the AV data is embedded in the display for 16 x 9 at the 4 x 3 screen ratio, and thus this case is not considered as preferable.

Second, a case where the AV data is synthesized with the markup document in a "background" mode using the property video-placement:

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displayed on the display having the 16 x 9 aspect ratio. Since only the window area of the synthesized scene is defined when displaying the scene even though the manufacturer encodes the AV data to a 16 x 9 size, in order to prevent the AV data from displaying in the letter box or pan & scan shape, as shown in (a) and (b) of FIG. 18, in another embodiment of the present invention, a scene can be displayed in the most appropriate shape according to an aspect ratio of a display or display modes (embedded mode, background mode, and PIP mode) by defining viewport and window properties only for a markup document and viewport and window properties only for AV data, respectively.

In FIG. 19, assuming that markup documents considering different aspect ratios of displays ③ and ④ and AV data (i.e., AV contents of DVD-video format) considering different aspect ratios of displays ⑤ and ⑥ exist in displays ① and ② for 4 x 3 and 16 x 9, resolution of displays is 720 x 480 having the same pixel number, as shown in FIG. 20, in the case of NTSC. Only, in a 16 x 9 aspect ratio, the ratio of width to length of a pixel is 1.78:1, as shown in (a) of FIG. 20, and in a 4 x 3 aspect ratio, the ratio of width to length of a pixel is 1.33:1.

In this way, if a display is a television (TV), the aspect ratio of a scene pixel varies according to the type of TV, and thus it is difficult to understand variations in a scene. Thus, for the convenience of explanation, a conversion equation with regard to each case of 1.78 x 1, 1.33 x 1, and 1 x 1 screen ratios will be described with reference to FIG. 21. Only, the length of a unit pixel is the same. Namely, in all cases, there are no variations in height.

Conversion ①: The resolution of 720 x 480 having a 16 x 9 pixel aspect ratio is converted into a shape having a 1 x 1 unit pixel aspect ratio.

Total horizontal resolution

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Total horizontal resolution

= normalization (when the length ratio of the unit pixel is 1, a width ratio, total vertical resolution)

= when the length ratio of the unit pixel is 1, a width ratio x total horizontal resolution

= 1.33 x 480

= around 640

Therefore, the resolution of 720 x 480 having a 4 x 3 pixel aspect ratio is consistent with the resolution of 640 x 480 having a 1 x 1 unit pixel aspect ratio. That is, when converting into a ③ shape, the following Equation is formed:

$$X(1.33:1) = \frac{720}{640} X(1:1)$$

$$X(1:1) = \frac{640}{720} X(1.33:1)$$

Conversion ④: Conversion between the resolution of 720 x 480 having a 16 x 9 pixel aspect ratio and the resolution of 720 x 480 having a 4 x 3 pixel aspect ratio

The following Equation is formed between the horizontal resolution having the 4 x 3 (12 x 9) pixel aspect ratio and the horizontal resolution having the 16 x 9 pixel aspect ratio.

$$X(1.78:1) = \frac{12}{16} X(1.33:1)$$

$$X(1.33:1) = \frac{16}{12} X(1.78:1)$$

That is, it is most appropriate that the 720 x 480 resolution in the display for 4 x 3 is displayed in 540 x 480 resolution in the display for 16 x 9, and thus when only an are (corresponding to "hot area") corresponding to 540 x 480 in the interactive contents for 16 x 9 is selected, the selected area is rightly displayed on the display for 4 x 3.

Meanwhile, if the 720 x 480 resolution having the 16 x 9 pixel aspect ratio is converted into a letter box shape in the 720 x 480

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		PIP mode				200 x 150
			640 x 480	640 x 480	640 x 480	determined by object tag
	16 x 9	Embedded mode	640 x 480	640 x 480	640 x 480	
		Background mode	640 x 480	640 x 480	640 x 480	640 x 480
		PIP mode	640 x 480	640 x 480	640 x 480	200 x 150 determined by object tag
4 x 3 markup document, 16 x 9 AV data	4 x 3	Embedded Mode	640 x 480	854 x 480	640 x 480	
		Background mode	640 x 480	640 x 480 (P)	640 x 480	640 x 480
		PIP mode	640 x 480	854 x 480	640 x 480	200 x 150 determined by object tag
	16 x 9	Embedded mode	640 x 480	854 x 480	640 x 480	
		Background mode	640 x 480	854 x 480	640 x 480	854 x 480
		PIP mode	640 x 480	854 x 480	640 x 480	272 x 153 determined by object tag
16 x 9 markup document, 4 x 3 AV data	4 x 3	Embedded mode	640 x 480	640 x 480	640 x 480	
		Background mode	640 x 480	640 x 480	640 x 480	640 x 480
		PIP mode	640 x 480	640 x 480	640 x 480	200 x 150 determined by object tag
	16 x 9	Embedded mode	854 x 480	640 x 480	854 x 480	
		Background mode	854 x 480	640 x 480	854 x 480	640 x 480
		PIP mode	640 x 480	640 x 480	854 x 480	200 x 150 determined by object tag
16 x 9 markup document, 16 x 9 AV data	4 x 3	Embedded mode	640 x 480	854 x 480	640 x 480	
		Background mode	640 x 480	640 x 480 (P)	640 x 480	640 x 480
		PIP mode	640 x 480	854 x 480	640 x 480	200 x 150 determined by object tag
	16 x 9	Embedded mode	854 x 480	854 x 480	854 x 480	

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x 3 normal shape, and this shape is a reduction shape of 16 x 9 AV data in which distortion in which a scene seems to be slim does not occur, unlike a conventional normal shape.

4 x 3L: If a user sets a screen output to a 4 x 3 letter box shape

4 x 3P: If a user sets a screen output to a 4 x 3 pan & scan shape

16 x 9W: If a user sets a screen output to a 16 x 9 wide shape

2. **"video-placement" property**

It designates a display mode of the AV scene. None, embedded, pip-#, and background represent nothing displayed, embedded mode, PIP mode, and background mode, respectively. An initial value is an embedded mode.

3. **background-color property**

It designates a background color of a scene formed of a single color. A value is <color>, and an initial value may vary according to a user agent (UA).

4. **"document-viewport" property**

It designates a trimming area of a markup document. A value is <shape>, and an initial value is rect (0%, 100%, 100%, 0%). Here, the value of the defined <shape> is rect(<top>,<right>,<bottom>,<left>).

5. **"document-window" property**

It designates an area of a window in which a markup document is displayed on a scene of a display. A value is <shape>, and an initial value is rect (0%, 100%, 100%, 0%).

6. **"video-viewport" property**

It designates a trimming area of the scene in which the AV scene is synthesized with the markup document scene. A value is <shape>, and an initial value is rect (0%, 100%, 100%, 0%).

7. **"video-window" property**

It designates an area of a window in which AV data is displayed

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```
@screen-display 16x9W
{
    background-color : #000000
    document-viewport : (0px,719px,479px,0px)
    document-window : (0px,719px,479px,0px)
    video-viewport : (0px,719px,479px,0px)
    video-window : (0px,719px,479px,0px)
}
```

Since the default style sheet is differently set in each reproducing apparatus, a scene cannot be usually displayed as the manufacturer wants. Thus, preferably, the manufacturer makes an additional CSS in the markup document and attaches the CSS to the document so that the AV data and the markup document can be effectively displayed even at an aspect ratio set by the user. The following example shows how the manufacturer makes the CSS in the markup document so that AV data for 16 x 9 and a markup document for 4 x 3 can be effectively displayed in a "background mode". The CSS may be made using a "style" tag, as shown the following example, and may be used through external reference using a "link" tag.

```
<!DOCTYPE html PUBLIC "-//DVD//DTD XHTML DVD-HTML 1.0//EN"
                      "http://www.dvdforum.org/enav/dtd/dvdhtml-1-0.dtd">
<html>
    <head>
        <title>Example of aspect ratio change</title>
        <style type="text/css">

        @screen-display 4x3N
        {
            video-placement : background
            background-color : #000000
            document-viewport : (0px,719px,479px,0px)
            document-window : (0px,719px,479px,0px)
            video-viewport : (0px,629px,479px,90px) // If the entire area is selected using a
viewport area, AV data displayed as a background seems to be slim.  Thus, in order to
solve this problem, the manufacturer just selects pan & scan.  A selection area may be
varied by the manufacturer.
            video-window : (0px,719px,479px,0px)
        }

        @screen-display 4x3L
        {
            video-placement : background
            background-color : #000000
            document-viewport : (0px,719px,479px,0px)
            document-window : (60px,719px,419px,0px)
```


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Here, "ScreenDisplayProperties" are connected to root elements of a markup document, and the value of "ScreenDisplayProperties" can be referred to using a script language in the markup document.

The definition and property of an interface definition language (IDL) are as follows.

IDL Definition

```
Interface ScreenDisplayRule
{
    readonly attribute   unsigned short   screenDisplayMode;
             attribute   unsigned short   videoPlacement;
             attribute   DOMString        colorBackground;
             attribute   DOMString        documentviewport;
             attribute   DOMString        documentwindow;
             attribute   DOMString        videoviewport;
             attribute   DOMString        videowindow;
 };
```

Attributes

screenDisplayMode: An aspect ratio of an output scene set by a user

```
const unsigned short SCREEN_DISPLAY_MODE_4X3NORMAL   = 0;
const unsigned short SCREEN_DISPLAY_MODE_4X3LETTERBOX  = 1;
const unsigned short SCREEN_DISPLAY_MODE_4X3PAN&SCAN   = 2;
const unsigned short SCREEN_DISPLAY_MODE_16X9WIDE = 3;
```

videoPlacement: It designates a display mode of a DVD-video

```
const unsigned short VIDEO_PLACEMENT_NONE   = 0;
const unsigned short VIDEO_PLACEMENT_EMBEDDED   = 1;
const unsigned short VIDEO_PLACEMENT_BACKGROUND   = 2;
const unsigned short VIDEO_PLACEMENT_PIP = 3;
```

colorBackground: It has the value of <color> as a background color of a DVD-video scene.

documentviewport: It has the value of <shape> as a trimming area of a markup document.

documentwindow: It has the value of <shape> as a window area on a display to which the trimmed markup document is to be mapped.

videoviewport: It has the value of <shape> as a trimming area of the DVD-video.

videowindow: It has the value of <shape> as a window area on a display to which the trimmed DVD-video is to be mapped. However, when videoPlacement is in an embedded mode, the window area is restricted by "width" and "height" defined by an <object> tag in the markup document.

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```
                vdi.colorBackground = "black";
                vdi.documentviewport = "(0px,629px,479px,90px)";
                vdi.documentwindow = "(0px,719px,479px,0px)";
                vdi.videoviewport = "(0px,629px,479px,90px)" // Part of a scene formed by
cutting right and left sides of the DVD-video picture will be selected.
            }

            if (evt.index == SCREEN_DISPLAY_MODE_CHANGE && (evt.param1 == 3))
            { // param1 == 3 : 16x9W
                vdi = document.documentElement.ScreenDisplayInfo;
                vdi.videoPlacement = 1;
                vdi.colorBackground = "black";
                vdi.documentviewport = "(0px,719px,479px,0px)";
                vdi.documentwindow = "(0px,719px,479px,0px)";
                vdi.videoviewport = "(0px,719px,479px,0px)"
            }

            }
        -->
        </script>

        <script type="text/javascript">
        <--
            function setupEventHandler()
            {
            // eventHandler is registered to bodyNode and Interactive Contents
            // SCREEN_DISPLAY_MODE_CHANGE ==  500
            bodyNode.addEventListener("dvdvideo",eventHandler,true);
            dvdVideo.SubscribeToEvent(SCREEN_DISPLAY_MODE_CHANGE,true);}
        -->
        </script>
    </head>

    <body id="bodyNode" onload="setupEventHandler()">
    .....
    </body>
</html>
```

The markup document is displayed in a scene through initial static definition, and then due to the occurrence of an event according to a user's aspect ratio conversion key (or button) input, "vdi.screenDisplayMode" information is read, thereby reconstituting the aspect ratio of the scene using a script language included in the above markup document.

FIG. 23 shows a flowchart of another preferred embodiment of a reproducing method according to the present invention. Referring to FIG. 23, by using the above-mentioned static and dynamic definitions,

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screen mode, and if there is a style sheet provided by the manufacturer in the markup document, the presentation engine 3 outputs the markup document to the scene, using the properties such as document viewport, document window, video viewport, and video window, according to @screen-display, which are defined in the corresponding style sheet.

In step 2304, it is determined whether the screen mode according to a user's aspect ratio conversion key (or button) is changed. In step 2305, if the screen mode is changed by the user, the presentation engine 3 informs the corresponding markup document of an aspect ratio conversion event ASPECT_RATIO_CHANGE, executes a script caused by the event, interprets a screen display property variable corresponding to the changed screen mode using ScreenDisplayProperties in the presentation engine 3, changes a screen output state of the markup document based on the interpreted information, and outputs a new markup document to the scene. In step 2306, if the screen mode is not changed in step 2304, it is determined whether the output of the markup document is terminated, and the output of the markup document is terminated.

The above recording and reproducing methods can be implemented with a computer program. Program codes and code segments of the computer program can be easily made by a computer programmer skilled in the art. Also, the above program is stored in information storage media (computer readable media), read and executed by the computer, thereby performing a method for recording and reproducing a markup document and AV data. The information storage media include magnetic recording media, optical recording media, and carrier waves.

Industrial Applicability

As described above, according to the present invention, an information storage medium including AV data and a markup document

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made therein without departing from the spirit and scope of the invention as defined by the appended claims.

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information includes a link tag recorded in the markup document, and a cascading style sheet (CSS) inserted in the link tag.

8. The medium of claim 7, wherein the CSS includes display mode designation information for designating a display mode of the AV scene.

9. The medium of claim 8, wherein the CSS further includes an AV trimming area designation information for designating an area to increase and reduce a desired portion of the AV scene.

10. The medium of claim 8, wherein the CSS further includes background color designation information for designating a background color of the AV scene.

11. The medium of claim 8, wherein the CSS further includes trimming area designation information for designating a trimming area of a scene in which the AV scene is synthesized with the markup document.

12. The medium of claim 8, wherein the CSS further includes window designation information for designating a window in which a scene where the AV scene is synthesized with the markup document is displayed on the screen of a display.

13. The medium of claim 8, wherein the CSS further includes screen display type information representing an aspect ratio of a scene in which the AV scene is synthesized with the markup document scene.

14. The medium of claim 8, wherein the CSS further includes window designation information of the AV scene for designating an area

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further include a screen display mode representing an aspect ratio of a scene in which the AV scene is synthesized with the markup document scene.

22. The medium of claim 16, wherein the property variables further include a property variable for designating a window in which a scene where the AV scene is synthesized with the markup document is displayed on the screen of the display.

23. The medium of claim 1, further comprising reproduction control information for the AV data, and the AV data is decoded as the AV scene by referring to the reproduction control information.

24. The medium of claim 1, wherein the AV data and the reproduction control information are recorded in a video directory, and the markup document and the scene synthesis information are recorded in an interactive directory.

25. An information storage medium comprising:

AV data including audio data and video data;

a markup document; and

scene synthesis information in which a markup document scene obtained from the markup document is synthesized with an AV scene obtained from the AV data without scene distortion corresponding the change of a screen mode.

26. The medium of claim 25, wherein the screen synthesis information is stored in a cascading style sheet (CSS) file linked to the markup document using a link tag or embedded in the markup document using a style tag.

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and unimportant contents are recorded or any contents are not recorded in other area.

31. The medium of claim 30, wherein when the markup document having a first aspect ratio is displayed on a display having a second aspect ratio having a resolution lower than that of the first aspect ratio, the hot area is selected using the trimming area designation information of the synthesized scene, and the selected hot area is mapped to a designated area on the screen of the display using the window designation information of the synthesized scene.

32. The medium of claim 26, wherein the screen synthesis information includes at least one of screen display type information for designating an aspect ratio of a scene in which the AV scene is synthesized with the markup document scene, display mode designation information for designating a display mode of the AV scene, background color designation information for designating a background color of the scene, markup document trimming area designation information for designating a trimming area of the markup document, markup document window designation information for designating a window in which the markup document scene is displayed on a screen of a display, AV trimming area designation information for designating an area to increase and reduce a desired portion of the AV scene, and window area designation information of the AV scene for designating a window in which only the AV scene is displayed on the screen of the display.

33. The medium of claim 32, wherein when the AV data having a first aspect ratio is displayed on a display having a second aspect ratio having a resolution lower than that of the first aspect ratio, the scene synthesis information is set so that the AV data having the first aspect ratio is output without conversion.

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designating a trimming area to increase and reduce a desired portion of the AV scene, a property for designating a window in which the AV scene is displayed on the screen of the display.

38. The medium of claim 37, wherein in response to user's screen mode conversion, the program using an object source controls a property for designating a trimming area of the synthesized scene, a property for designating a window area of the markup document scene, a property for designating a trimming area of the AV scene, and a property for designating a window area of the AV scene according to the screen display mode, thereby reconstituting the aspect ratio of the scene.

39. The medium of claim 25, wherein conversion between a screen ratio and an aspect ratio according to the screen mode includes conversion of a 720 x 480 resolution having a 16 x 9 pixel aspect ratio into a 1 x 1 unit pixel aspect ratio, conversion between a 854 x 480 resolution and 640 x 480 resolution each having a 1 x 1 unit pixel aspect ratio, conversion of a 720 x 480 resolution having a 4 x 3 pixel aspect ratio into a 1 x 1 unit pixel aspect ratio, conversion of a 720 x 480 resolution having a 4 x 3 pixel aspect ratio into a 1 x 1 unit pixel aspect ratio, and conversion between a 720 x 480 resolution having a 16 x 9 pixel aspect ratio and a 720 x 480 resolution having a 4 x 3 pixel aspect ratio.

40. The medium of claim 27, wherein the screen display type information includes 4 x 3 normal, 4 x 3 letterbox, 4 x 3 pan & scan, and 16 x 9 wide.

41. A method for recording AV data including audio data and video data on an information storage medium, the method comprising:

(a) recording the AV data;

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46. The method of claim 45, wherein the display mode designation information indicates at least one of an embedded mode in which at least the AV scene is embedded in at least part of the markup document scene, a picture in picture (PIP) mode in which the AV scene is overlapped on the markup document scene, and a background mode in which the markup document scene is overlapped on the AV scene.

47. The method of claim 45, wherein in step (b), contents which should be displayed, are recorded in a maximum area shown regardless of an aspect ratio of the display, that is, a hot area, and unimportant contents are recorded or any contents are not recorded in the other area.

48. The method of claim 47, wherein when the markup document having a first aspect ratio is displayed on a display having a second aspect ratio having a resolution lower than that of the first aspect ratio, the hot area is selected using the trimming area designation information of the synthesized scene, and the selected hot area is mapped to a designated area on the screen of the display using the window designation information of the synthesized scene.

49. The method of claim 45, wherein the scene synthesis information further includes window designation information of the AV scene for designating a window in which the AV scene is displayed on the scene of the display.

50. The method of claim 43, wherein in step (c), an object having property variables for controlling the CSS and a program for controlling the CSS on the basis of the object are recorded.

51. The method of claim 50, wherein the property variables include at least one of a screen display mode for designating an aspect ratio of a scene in which the AV scene is synthesized with the markup

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a property for designating a window area of the markup document scene, a property for designating a trimming area of the AV scene, and a property for designating a window of the AV scene area according to the screen display mode, thereby reconstituting the aspect ratio of the scene.

55. A method for reproducing AV data including audio data and video data recorded on an information storage medium, the method comprising:

(a) interpreting a markup document to be displayed together with the AV data;

(b) interpreting scene synthesis information which describes at least two display modes for displaying a markup document scene obtained by reproducing the markup document and an AV scene obtained by reproducing the AV data together; and

(c) displaying the AV scene and the markup document scene in one of the display modes according to the interpreted scene synthesis information.

56. The method of claim 55, wherein step (c) includes displaying by embedding the AV scene in at least part of the markup document scene.

57. The method of claim 55, wherein step (c) includes displaying by using a picture in picture (PIP) technique for overlapping the AV scene on the markup document scene.

58. The method of claim 55, wherein step (c) includes displaying by overlapping the AV scene and the markup document scene.

59. The method of claim 55, wherein step (b) includes

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document scene, markup document window designation information for designating a window in which the markup document is displayed on a screen of a display, AV trimming area designation information for designating an area to increase and reduce a desired portion of the AV scene, and AV scene window designation information for designating a window in which the AV scene is displayed on the screen of the display.

64. The method of claim 61, wherein step (b) further includes interpreting a program being coded on the basis of an object having property variables for controlling the CSS and for controlling the CSS.

65. The method of claim 64, wherein step (b13) further includes increasing/reducing an output AV scene by controlling a property for designating a display mode of the AV scene and a property for designating a trimming area of the AV scene to increase and reduce a desired portion of the AV scene according to a user's input by the program using an object source.

66. The method of claim 64, wherein step (b13) further controlling a property for designating a trimming area of the synthesized scene, a property for designating a window area of the synthesized scene, and a property for designating a trimming area of the AV scene according to the screen display mode by the program using an object source in response to user's screen mode conversion, thereby reconstituting the aspect ratio of the scene.

67. The method of claim 64, wherein step (b13) further includes controlling a property for designating a trimming area of the markup document scene, a property for designating a window area of the markup document scene, a property for designating a trimming area of the AV scene, and a property for designating a window area of the AV scene

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synthesis information defined in a corresponding style sheet if there is a style sheet in the markup document.

70. The method of claim 69, wherein step (b3) comprises:

(b31) determining whether a scene mode is changed by the user;

(b32) if the scene mode is changed, transmitting scene mode change control information to the markup document and executing a script therefrom; and

(b33) changing the output state of the markup document scene in response to scene mode change using screen display properties.

71. The method of claim 70, wherein step (b33) includes in an embedded mode of an interactive mode or a PIP mode, outputting the AV data at a first aspect ratio when the AV data having the first aspect ratio is displayed on a display having a second aspect ratio having a resolution lower than that of the first aspect ratio, and in a background mode of the interactive mode or video mode, outputting the AV data in a pan & scan or letterbox shape.

72. The method of claim 69, wherein step (b) comprises:

(b1) selecting a default style sheet in the reproducing apparatus on the basis of a set scene mode;

(b2) reading scene synthesis information defined in the selected default style sheet including markup document window designation information for designating a window in which the markup document scene is displayed on the screen of the display, markup document trimming area designation information for designating a trimming area of the markup document scene, AV trimming area designation information for designating an area to increase and reduce a desired portion of the AV scene, and AV window area designation information for designating a

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a decoder which decodes the AV data read by the reading unit and outputs an AV scene; and

a controller which interprets the markup document read by the reading unit, outputs a markup document scene, interprets scene synthesis information which describes at least two display modes for displaying the markup document scene together the AV scene, and displays the AV scene and the markup document scene in one of the display modes according to the interpreted scene synthesis information.

76. The apparatus of claim 75, wherein the scene synthesis information includes at least one of display mode designation information for designating a display mode of the AV scene, background color designation information for designating a background color of the scene, trimming area designation information for designating a trimming area of a scene in which the AV scene is synthesized with the markup document scene, window designation information for designating a window in which the synthesized scene is displayed on a screen of a display, and AV trimming area designation information for designating an area to increase and reduce a desired portion of the AV scene.

77. The apparatus of claim 76, wherein the display mode designation information indicates at least one of an embedded mode in which at least the AV scene is embedded in at least part of the markup document scene, a picture in picture (PIP) mode in which the AV scene is overlapped on the markup document scene, and a background mode in which the markup document scene is overlapped on the AV scene.

78. The apparatus of claim 75, wherein the controller interprets a cascading style sheet (CSS) linked to or embedded in the markup document and interprets a program being coded on the basis of property variables for controlling the CSS and for controlling the CSS.

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color designation information for designating a background color of the scene, trimming area designation information for designating a trimming area of a scene in which the AV scene is synthesized with the markup document scene, window designation information for designating a window in which the synthesized scene is displayed on a screen of a display, and AV trimming area designation information for designating an area to increase and reduce a desired portion of the AV scene.

83. The apparatus of claim 82, wherein the display mode designation information indicates at least one of an embedded mode in which at least the AV scene is embedded in at least part of the markup document scene, a picture in picture (PIP) mode in which the AV scene is overlapped on the markup document scene, and a background mode in which the markup document scene is overlapped on the AV scene.

84. The apparatus of claim 83, wherein the controller interprets a cascading style sheet (CSS) linked to or embedded in the markup document and interprets a program being coded on the basis of property variables for controlling the CSS and for controlling the CSS.

85. The apparatus of claim 84, wherein the controller controls a property for designating a trimming area of the synthesized scene, a property for designating a window area of the synthesized scene, and a property for designating a trimming area of the AV scene in the style sheet file interpreted according to a screen display property, by the program using an object source in response to user's scene mode change.

86. The apparatus of claim 83, wherein the controller controls that in an embedded mode of an interactive mode or a PIP mode, when the AV data having a first aspect ratio is displayed on a display having a

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trimming area designation information and window area designation information of the markup document scene and trimming area designation information and window area designation information of the AV scene, which are respectively defined, when the AV data having the first aspect ratio is displayed on a display having a second aspect ratio having a resolution lower than that of the first aspect ratio.

90. The apparatus of claim 81, further comprising a blender which displays the AV scene and the markup document scene together by a display command according to the scene synthesis information interpreted by the controller.

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FIG. 3

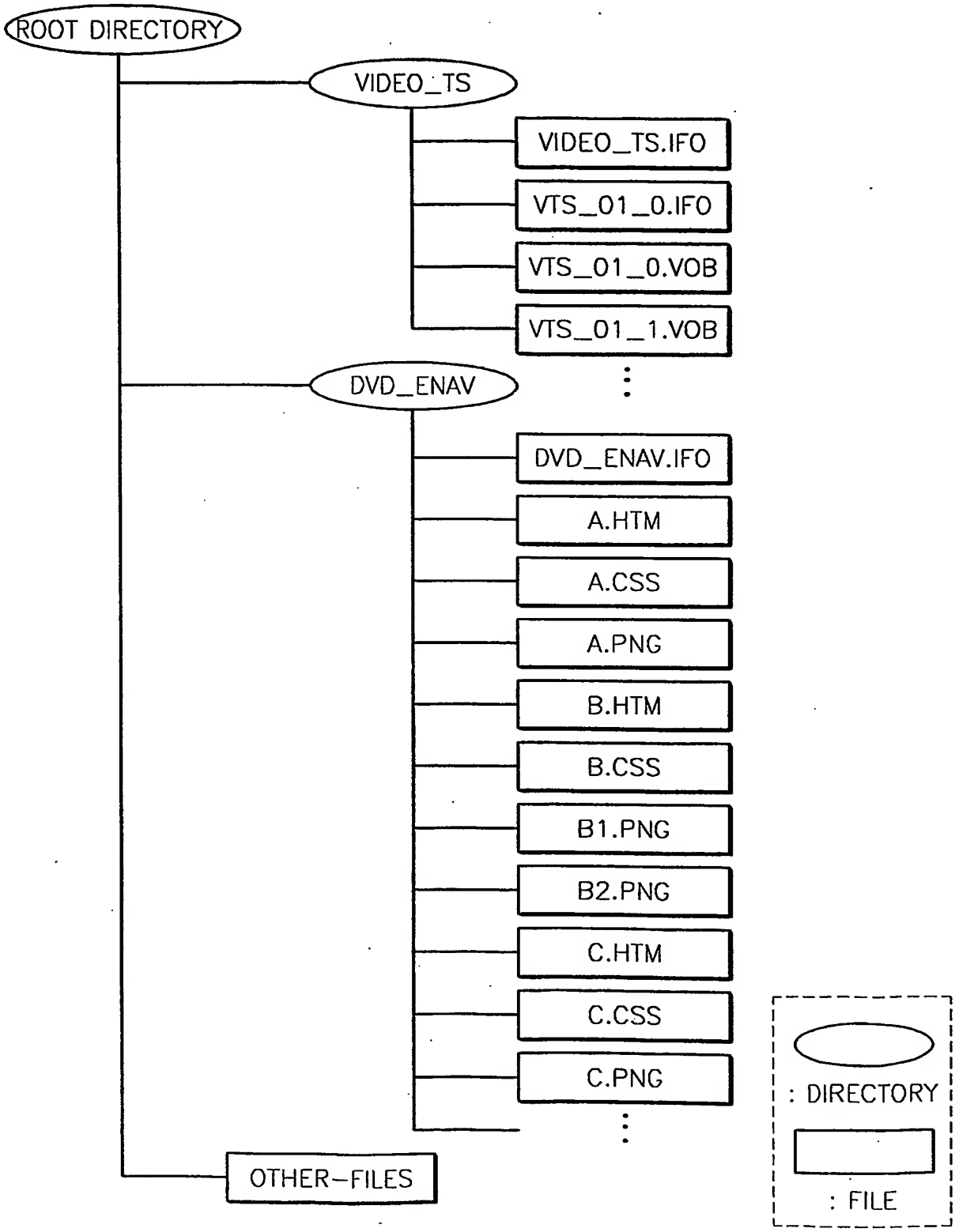

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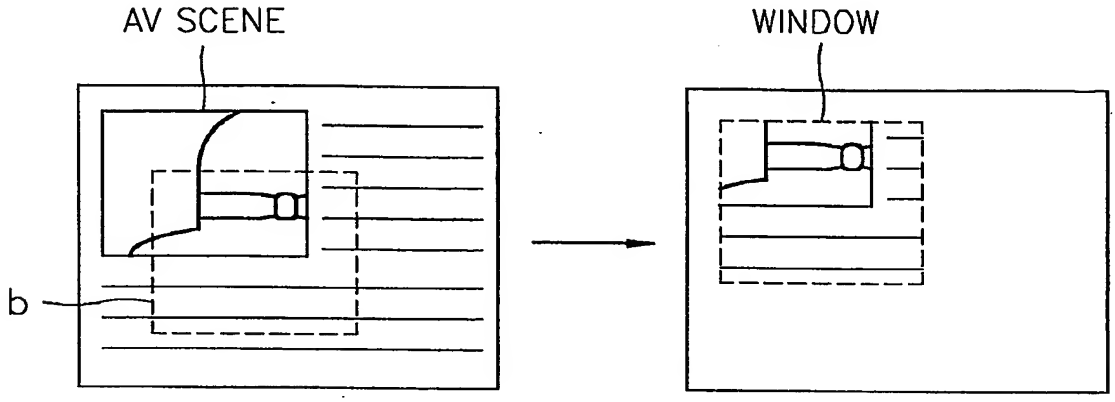
FIG. 6

Paramount
Pop quiz
What was the last movie in which this actress starred?

FIG. 8



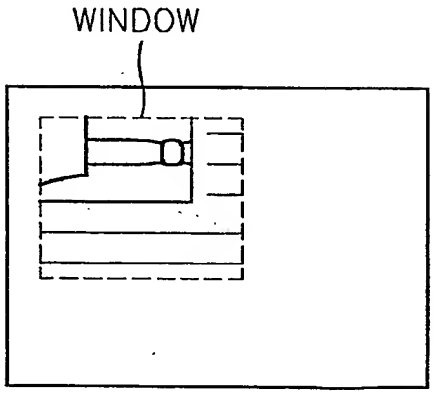


FIG. 10

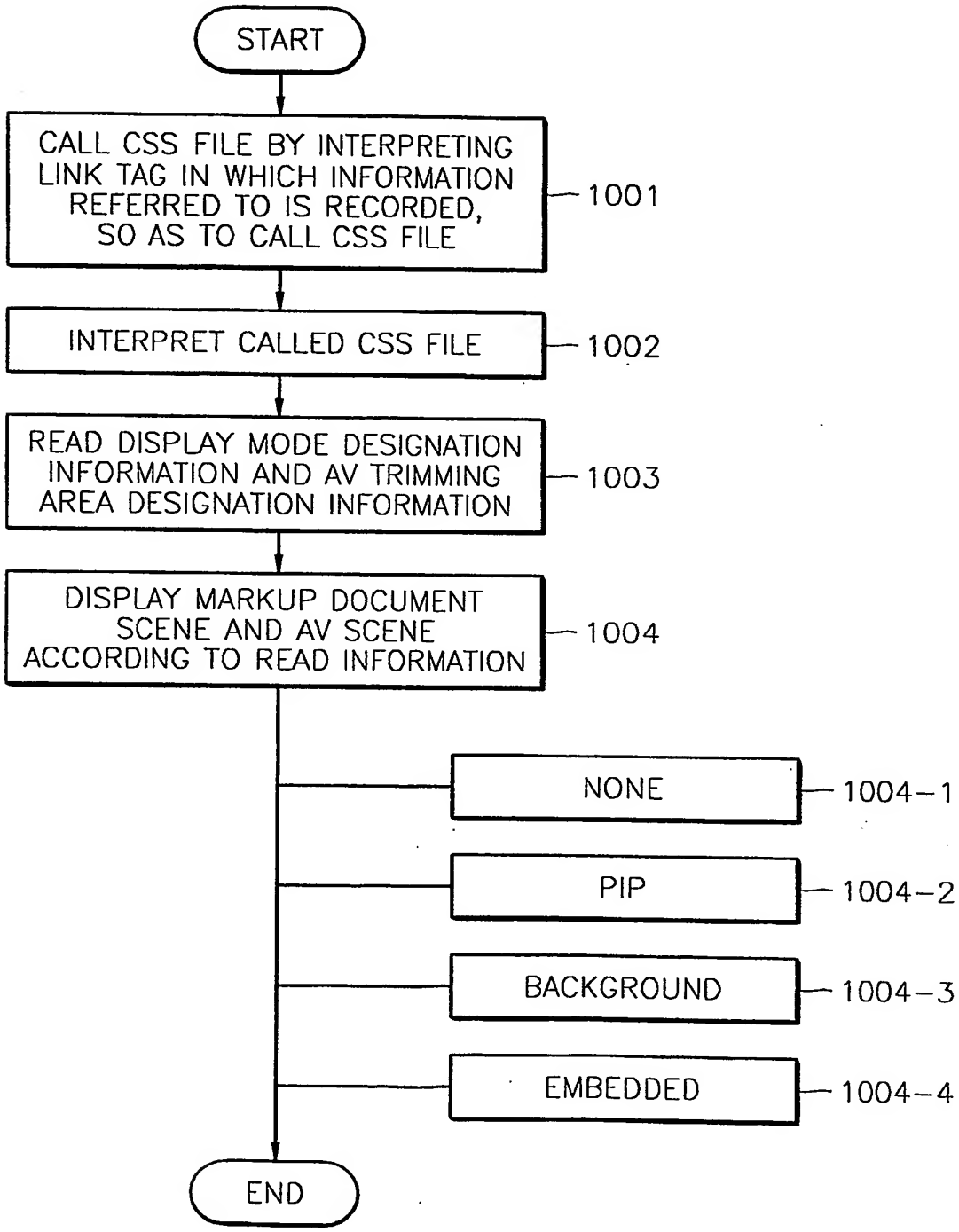

START
CALL CSS FILE BY INTERPRETING LINK TAG IN WHICH INFORMATION REFERRED TO IS RECORDED, SO AS TO CALL CSS FILE
1001
INTERPRET CALLED CSS FILE
1002
READ DISPLAY MODE DESIGNATION INFORMATION AND AV TRIMMING AREA DESIGNATION INFORMATION
1003
DISPLAY MARKUP DOCUMENT SCENE AND AV SCENE ACCORDING TO READ INFORMATION
1004
NONE
1004-1
PIP
1004-2
BACKGROUND
1004-3
EMBEDDED
1004-4
END

FIG. 12

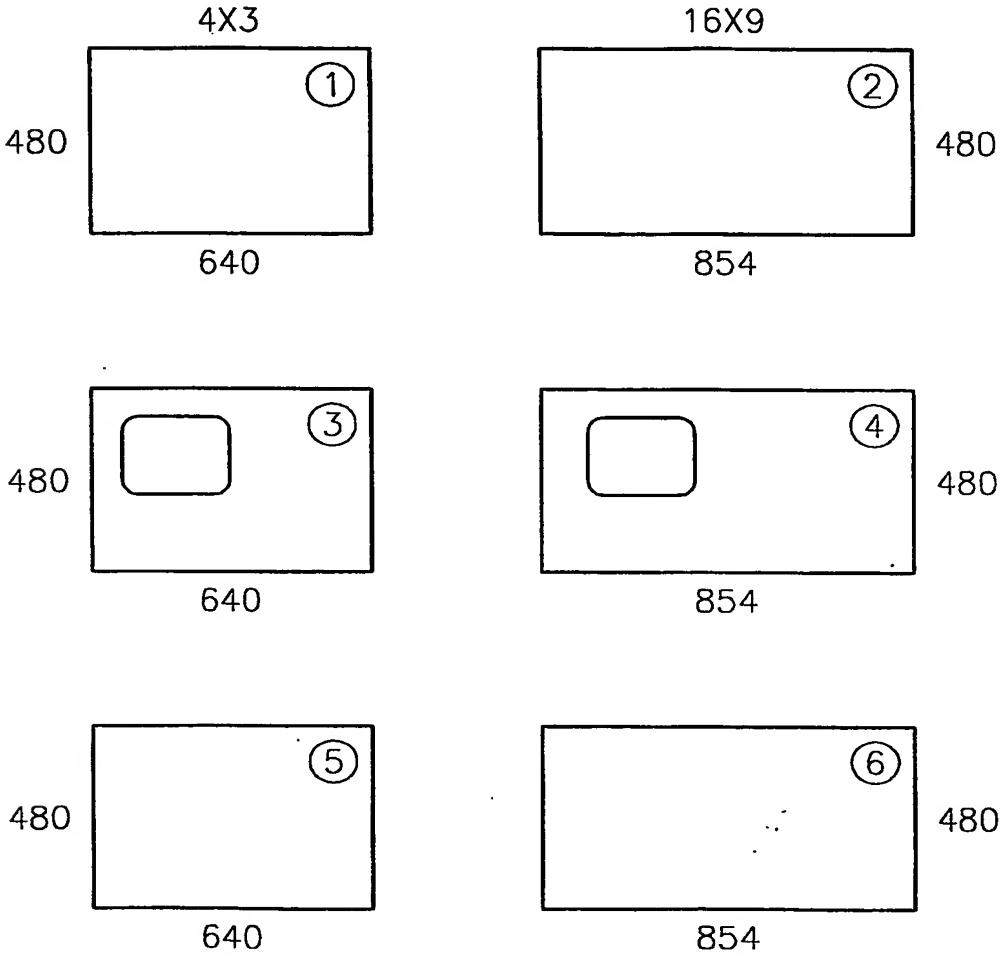


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FIG. 15

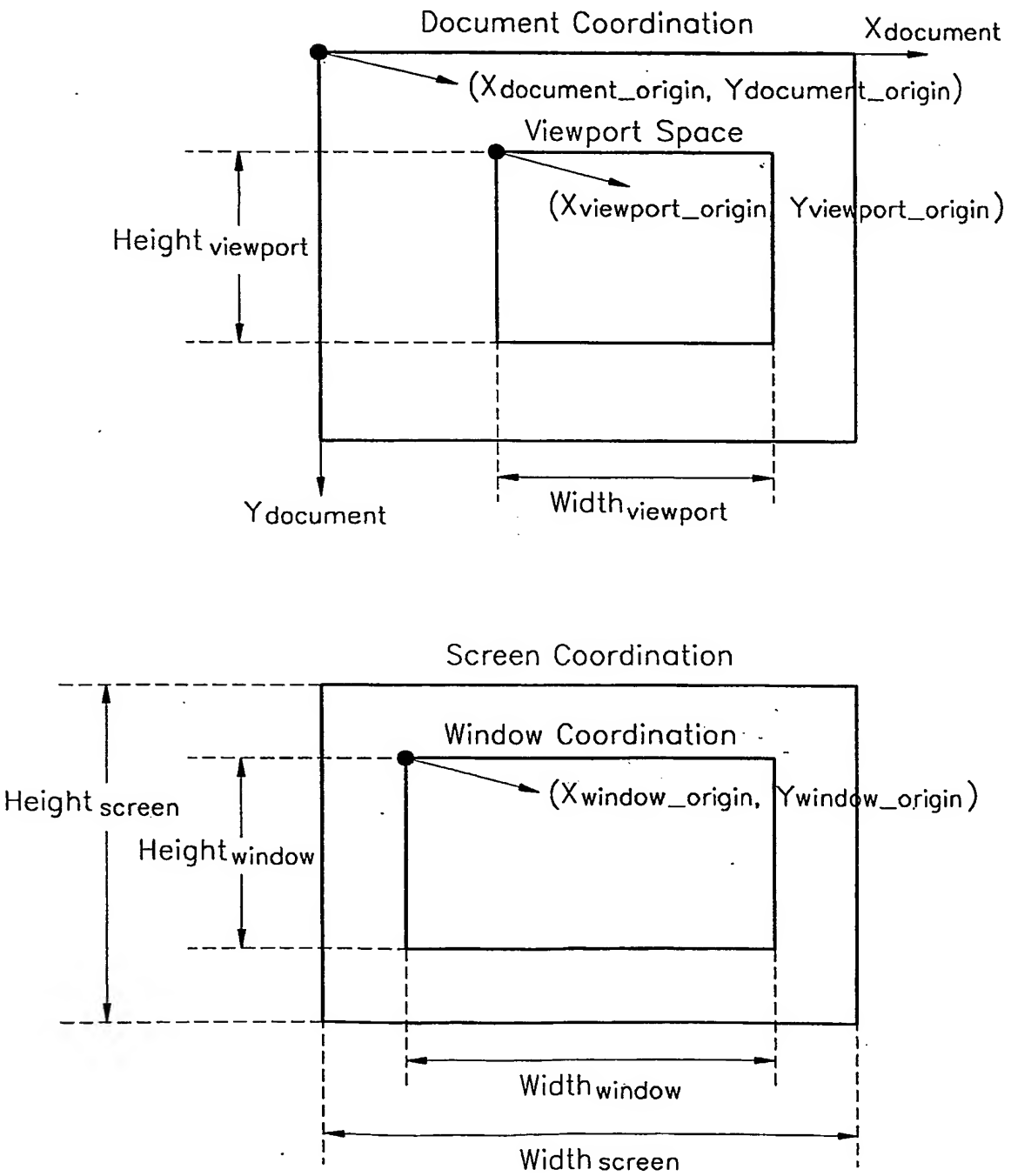
Document Coordination
Xdocument
(Xdocument_origin, Ydocument_origin)
Viewport Space
(Xviewport_origin, Yviewport_origin)
Height viewport
Ydocument
Width viewport
Screen Coordination
Window Coordination
(Xwindow_origin, Ywindow_origin)
Height screen
Height window
Width window
Width screen

FIG. 17

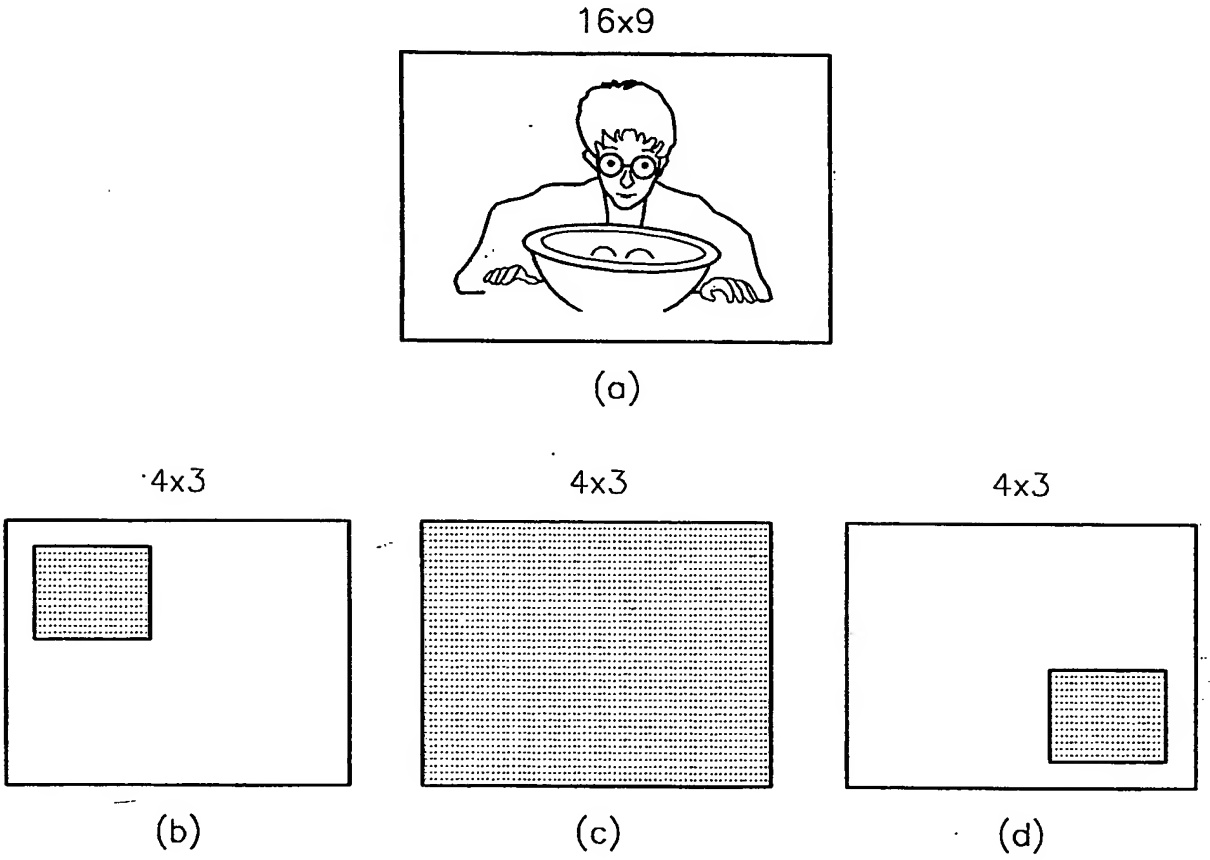

FIG. 19

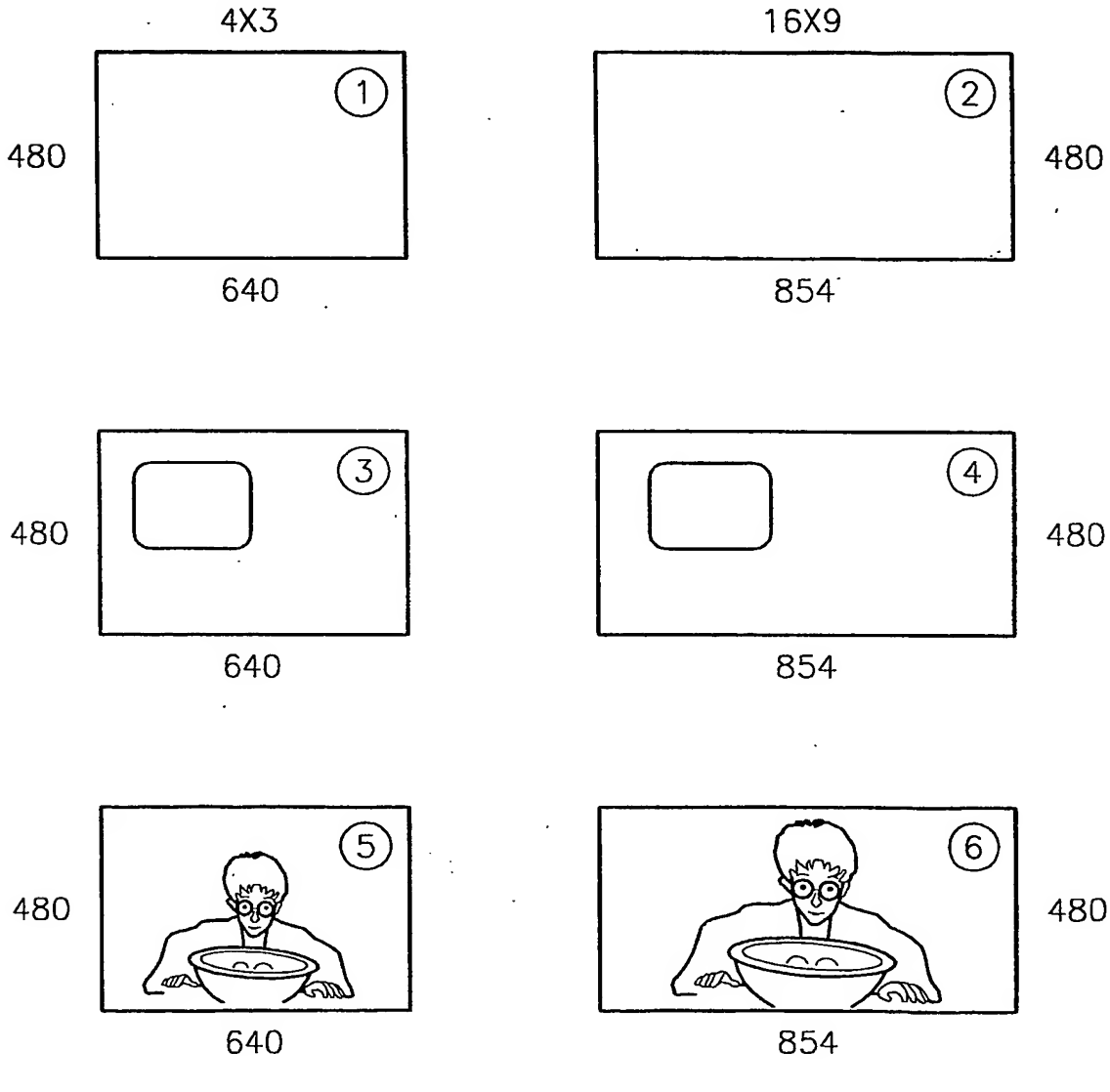

FIG. 21

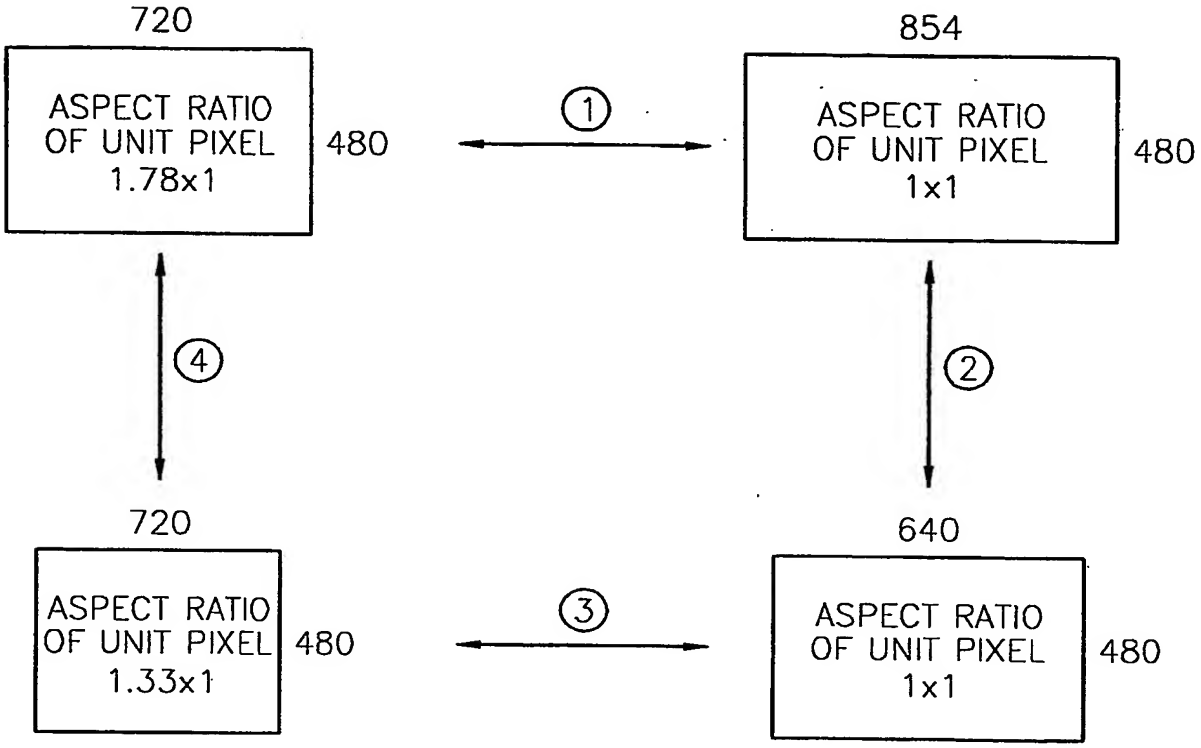

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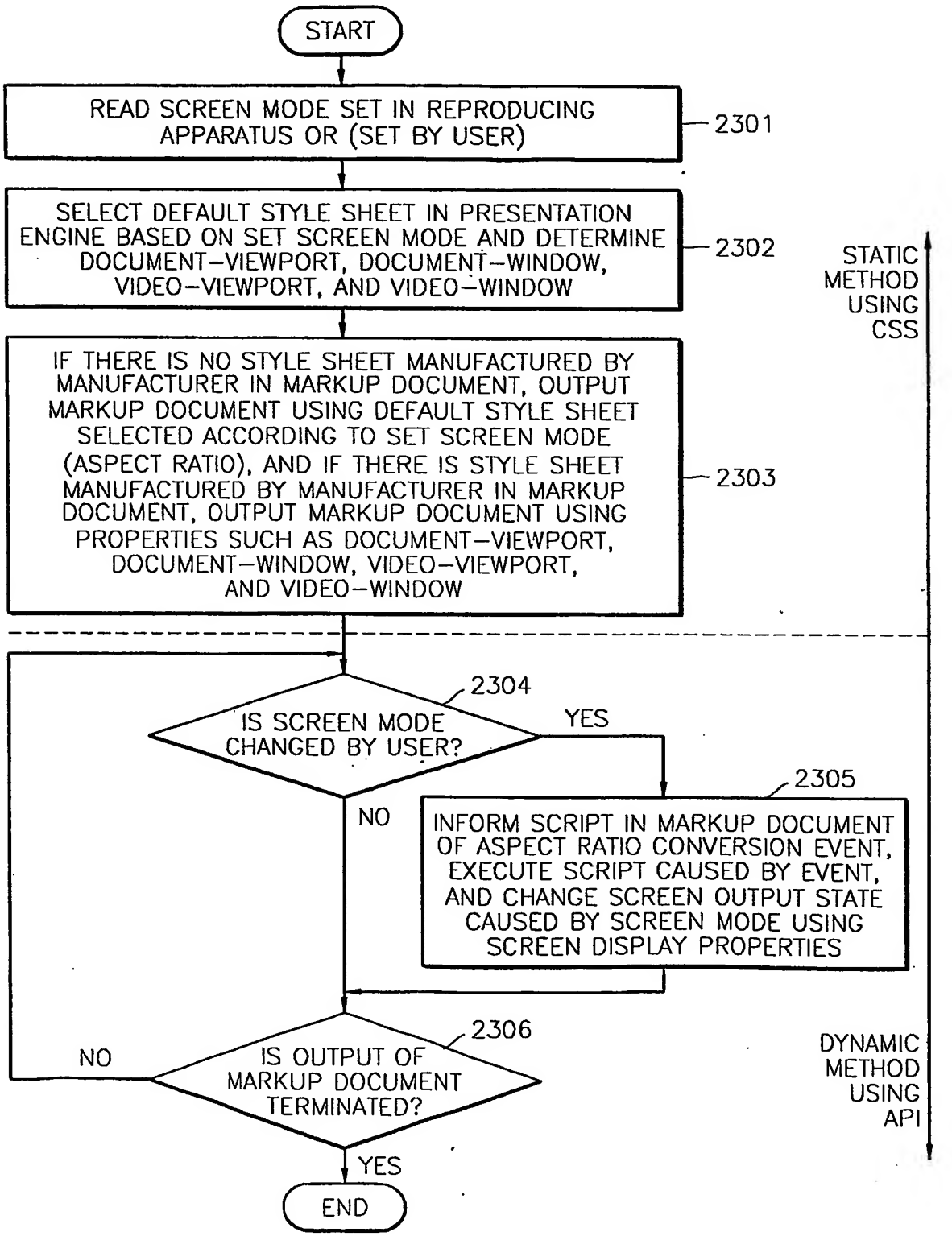
FIG. 23



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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR02/01977

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 99-26743 A	15.04.99	None	
KR 01-39796 A	15.05.01	EP 1077421 A2	02.21.01
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		CN1286436 A	03.07.01
KR 01-10471 A	15.02.01	None	

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